

## LEAF MICRO-MORPHOLOGICAL CHARACTERISTICS OF SELECTED *VATICA* SPECIES (DIPTEROCARPACEAE) FROM KUBAH NATIONAL PARK, SARAWAK

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### ABSTRACT

Genus *Vatica* L. is one of the largest groups in the family Dipterocarpaceae with 71 species have been botanically described, distributed from India, Sri Lanka to Myanmar, Indochina, Sumatra, Borneo and the Philippines. Borneo with 35 species has the largest representative. In Sarawak, 32 species have been recorded, occurring especially in mixed and upper dipterocarp forests and also non-saline habitats from sea level up to about 1,800 m altitude. Kubah National Park is among the richest site for genus *Vatica* in Sarawak with 11 species recorded. The *Vatica* species are distinguished from other genera of Dipterocarpaceae by the absence of looped intra-marginal nerves on leaf, winged fruits encloses less than half of the nut, glabrous anthers and stout style. However, in term of inter species within its genus, *Vatica* is the most difficult dipterocarp to be identified, which explains why this common genus so poorly known. This study was conducted to examine leaves characteristics particularly its micro morphology to differentiate some selected *Vatica* species from Kubah National Park. Leaves samples were observed via Scanning Electronic Microscope (SEM). The characteristics and indumentums were compared between each species and noted. Results show that leaf micro morphology characteristics are significantly useful to differentiate the species level and intra-specific level.

**Key words:** *Vatica*, Dipterocarpaceae, *Resak*, Kubah National Park, Sarawak, SEM

### INTRODUCTION

The genus *Vatica* L. is one of the largest natural groups in the family Dipterocarpaceae with 71 species have been botanically described that distributed from India, Sri Lanka to Myanmar, Indochina, Sumatra, Borneo and the Philippines (Srinual & Thammathaworn, 2008). Borneo with thirty-five species has the largest representative (Symington, 2004). In Sarawak, 32 species have been recorded that occurring especially in mixed and upper dipterocarp forests and also non-saline habitats at elevation from sea level up to about 1,800 m altitude (Ashton, 2004). The *Vatica* species are distinguished from other genera of the Dipterocarpaceae by the absence of looped intra-marginal nerves on the leaves, the winged fruits enclose less than half of the nut, anthers are glabrous

and the style is stout (Ashton, 1982; Pooma & Newman, 2001; Srinual & Thammathaworn, 2008).

Systematic study on the genus *Vatica* have been carries out by many researchers, among them are Ashton (1982; 2004); Maury-Lechon and Curtet (1998); Smitinand *et al.* (1980); Srinual & Thammathaworn, (2008) and Symington (2004). Molecular phylogeny studies also have been addressed, i.e. Indrioko *et al.* (2006) and Cao *et al.* (2006) to add on valuable taxonomic information on the family Dipterocarpaceae.

Anatomical features of the leaves in the Dipterocarpaceae in terms of paracytic stomata; the presence of large crystals and resin canals in the mesophyll was first highlighted by Solereder (1908). This then supported by Metcalfe & Chalk (1957) reported the important of stomata types, distribution and types of trichomes, the resin canals, the crystals in the mesophyll as informative characteristics. Studies by Tewary & Sarkar (1985); Rojo (1987) and

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Srinual & Thammthaworn (2008) added on the important characteristics on the leaf features in the genus *Vatica*. However, this kind of studies never been conducted for *Vatica* species in Sarawak, therefore our study aimed to investigate leaf micro morphological characteristics to be use for taxonomical purposes.

## MATERIALS AND METHODS

Fresh specimens used for this work were obtained from the Kubah National Park and Matang Wildlife Centre. Herbarium specimens were obtained from the Herbarium of Sarawak Forest Department (SAR) and Herbarium of Universiti Malaysia Sarawak (HUMS). Leaves of fresh specimens of the selected species that were collected in the field were fixed in 80 percent of Formalin-acetic acid-alcohol (FAA), as modified from Martinez-Cabrera *et al.* (2009). While leaves from the herbarium specimens were rehydrated in 5% NaOH at 60°C for one hour and fixed in FAA for 24 hours (Martinez-Cabrera *et al.*, 2009). Five critical points on the leaf, e.g. petiole, midrib, margin, lamina and glandular mark were selected and cut into smaller portions, 1 cm squares for observations under the Scanning Electron Microscopic (SEM). The samples then were undergoes into process of Critical Point Drying (CPD) before coated with the Palladium (Pd) fine particles using Auto Fine Coater (model JEOL JFC-1600). The coated samples then placed into the Analytical Scanning Electron Microscopic (model JOEL JSM-6390LA). The micro morphological on the leaf surface was observed via various magnifications. The presence of indumentums and suspicious textures on the leaf were observed, noted and analysed.

## RESULTS AND DISCUSSION

The cuticular ornamentation on the outer wall of the epidermal cells of the adaxial surface are varies among the five species. All the five species showed the presence of trichomes and stomata on the adaxial leaf surface (Table 1). Two types of trichomes were

observed on the leaf surface of the five *Vatica* species from Kubah National Park, i.e. stellate and peltate. The stellate trichomes were observed present in all the five species and the combinations with peltate trichomes type observed in three species, i.e. *V. coriacea* Ashton, *V. globosa* Ashton and *V. pedicellata* Brandis. Two stomata types were observed, cyclocytic and actinocytic similar as reported by Rojo (1987). *V. coriacea* and *V. pedicellata* were the two species with actinocytic type covered in this study. According to Srinual & Thammthaworn (2008), most of the *Vatica* species are with typical stomata level and only few species are with raised level type. This characteristic probably was a good criterion for divisional level. Two species were observed with raised stomata level in this study, i.e. *V. badiifolia* Ashton and *V. pedicellata*.

The measurements on the average of stomata, resin gland and stellate trichomes of the five *Vatica* species from Kubah National Park were showed in Table 2. The stomata of *V. coriacea* were the largest among the five species with average length 32.83 µm and average wide 22.76 µm. We believed that the sizes of stomata perhaps influenced by the thickness and textures of the leaves and as well as natural habitat of the species. As far as we are concerned, *V. coriacea* was the only species in Sarawak has wider distribution and abilities to grown on infertile soils such kerangas forest, limestone, semi-mangrove forest and rocky habitat. This species has special leaves characteristic, thick with coriaceous texture and margin curved inward. The resinous gland of *V. pedicellata* were the largest among the five *Vatica* species from Kubah National Park with average length 39.23 µm and average wide 39.30 µm which against with the sizes of stomata recorded as the smallest among the five species with average length 15.20 µm and average wide 17.43 µm. The leaves of *V. pedicellata* were less thickness and coriaceous compared with *V. coriacea*, but differs by the presence of glaucous appearance on lower surface of leaf. This species however, so far recorded to be restricted to kerangas forest areas.

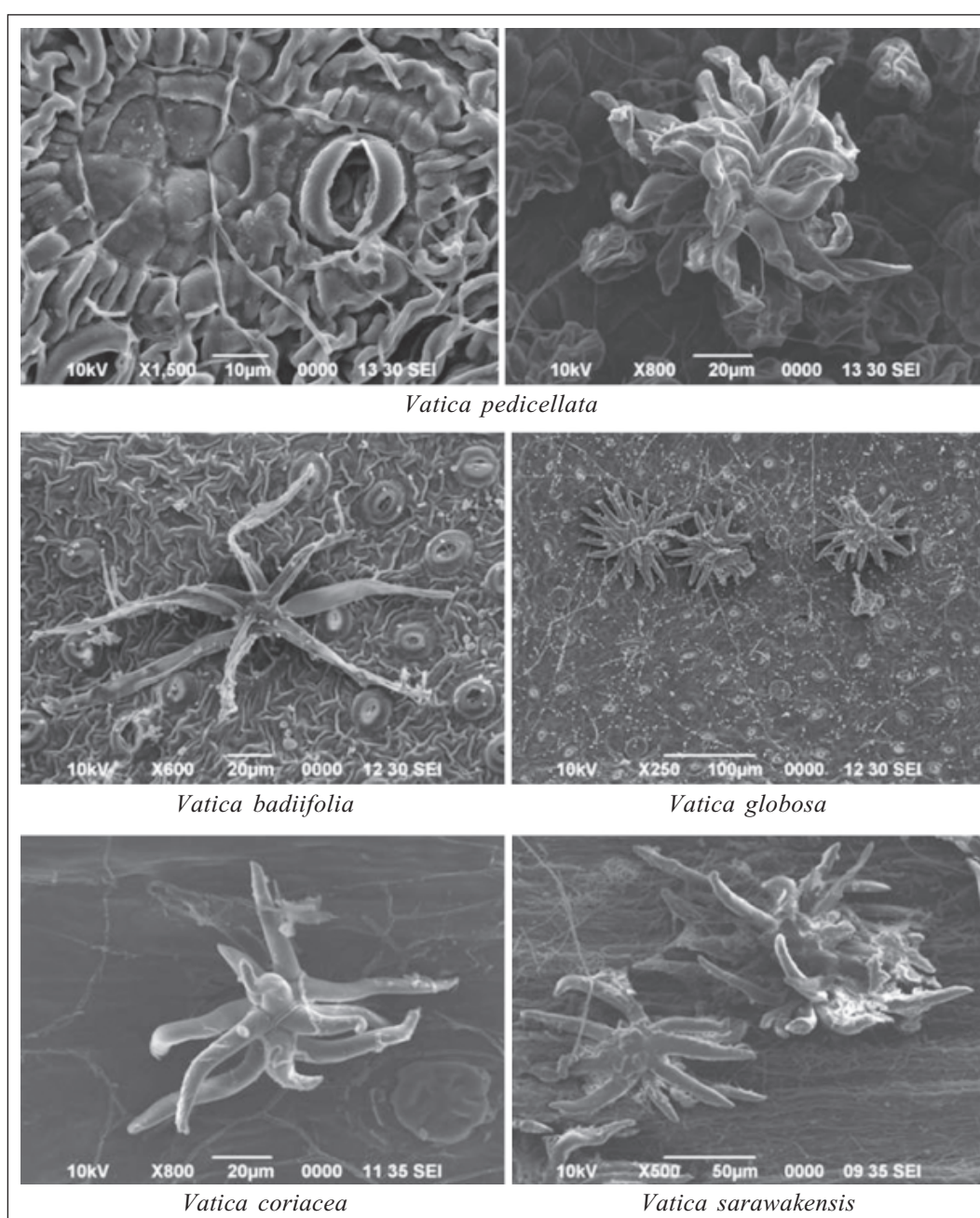
Two types of trichomes were observed on the leaves of *Vatica* species from Kubah National Park, i.e. stellate and peltate trichomes (Figure 1). The

**Table 1.** Morphological characters of the five *Vatica* species from Kubah National Park

Species	Trichomes	Stomata	Stomata level
<i>Vatica badiifolia</i>	stellate	actinocytic	raised
<i>Vatica coriacea</i>	peltate and stellate	cyclocytic	typical
<i>Vatica globosa</i>	peltate and stellate	cyclocytic	typical
<i>Vatica pedicellata</i>	peltate and stellate	actinocytic	raised
<i>Vatica sarawakensis</i>	stellate	cyclocytic	typical

**Table 2.** Measurements of stomata, resin gland and stellate trichomes of the five *Vatica* species from Kubah National Park

Species	Stomata		Resin gland		Stellate trichome	
	Ave. length (µm)	Ave. wide (µm)	Ave. length (µm)	Ave. wide (µm)	No. of segments	Ave. length (µm)
<i>Vatica badiifolia</i>	19.03	20.03	26.83	25.73	8 – 13	51.64
<i>Vatica coriacea</i>	32.83	22.76	32.05	28.48	11 – 15	43.32
<i>Vatica globosa</i>	21.60	18.87	26.20	23.37	27 – 31	38.23
<i>Vatica pedicellata</i>	15.20	17.43	39.23	39.30	8 – 12	44.40
<i>Vatica sarawakensis</i>	21.50	19.40	18.80	19.50	10 – 25	58.46

**Fig. 1.** SEM images (various magnifications) to show the micro morphological presence on the leaf surface of *Vatica* species (top: *V. pedicellata* – stomata and resinous mark on the glandular mark (left); stellate trichome; middle and bottom, left to right; *V. badiifolia*, *V. globosa*, *V. coriacea* and *V. sarawakensis*, to show the stomata, resinous glands and stellate trichomes).

numbers of segments on the stellate trichomes were counted and the average lengths of segments were measured during the study. *V. badiifolia* and *V. pedicellata* almost have a similar average number of segments, 8–13 but differs by the average length of segments 51.64 µm and 44.40 µm respectively. The stellate trichomes on the leaves of *V. globosa* were most complicated with number of segment more than 27 compare with other with range 8–25 segments.

## CONCLUSION

Five critical points on leaf part were examined for this study found that the similarities and dissimilarities between the five *Vatica* species from Kubah National Park. The stellate trichomes were found occurred on all the species examined at all the five critical points. Provisionally our hypothesis assured that the stellate trichomes to be one of the similarity characters belong almost of *Vatica* species. Two types of stomata, actinocytic and cyclocytic with two levels, raised and typical were discovered on the leaves of *Vatica* species in Sarawak. The sizes of stomata and resin glands and segment length of stellate trichomes of the five species of *Vatica* from Kubah National Park showed a significant difference among the species. More comprehensive study is in progress to include other *Vatica* species and species from other genera in the tribes Dipterocarpoidea, such as *Anisoptera*, *Cotylelobium*, *Dipterocarpus* and *Upuna* for comparisons.

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